Network Analysis - Notes

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Contents

Introduction

This document is a compilation of notes made in the Circuit Analysis course of 2014 at the University of Twente. The structure is a bit different than the one used in the course; this overview starts with a list of the basic building blocks and after that the *node voltage method* and the *phasor domain* will be introduced. (The *mesh current method* is left out for now, but might be added later.)

Chapter 1

Building blocks

The first chapter explains the basic principles that can be used in network analysis. The examples use resistances, but the same principles are valid for impedances, which will be explained in chapter 2. All of the tools help in solving and simplifying circuits. Simplification of circuits can make a huge difference in how easy a network can be solved.

1.1 Kirchhoff's current law

Kirchhoff's first law states that the sum of the currents flowing from and towards a node is zero, or:

$$\sum_{k=1}^{n} i_k = 0$$

This means that there can never be a current remaining in a node. When writing the equation, current flowing towards the node is marked as positive and current flowing from the node is marked as negative. For the circuit in figure 1.1, the following formula can be formed:
$i_1 - i_2 - i_3 + i_4 = 0$.

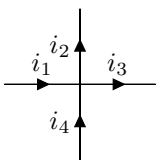

Figure 1.1: Example of Kirchhoff's current law.

1.2 Kirchhoff's voltage law

Following the first law, Kirchhoff's second law or voltage law tells that the sum of the voltages in a closed loop is equal to zero. This can be expressed as the following formula:

$$\sum_{k=1}^{n} v_k = 0$$

Figure 1.2 shows an example circuit. The formula for the circuit is formed like this: $-v_s + v_{R1} + v_{R2} + v_{R3} = 0$.

Note that the voltage in a voltage source is negative.

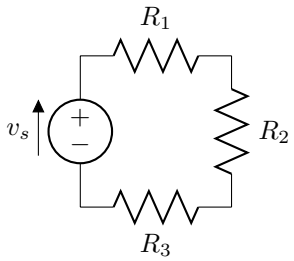

Figure 1.2: Example of Kirchhoff's voltage law.

1.3 Series reduction

1.4 Parallel reduction

1.5 Voltage divider

1.6 Current divider

1.7 Thèvenin equivalent source

1.8 Norton equivalent source

1.9 Source transformation

1.10 Superposition

Chapter 2

The node voltage method

Chapter 3

The phasor domain

Appendices

Appendix A

Element equations

Appendix B

Complex numbers

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